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The life-cycle of *Astiotrema trituri* B. Grabda, 1959
(Trematoda—Plagiorchiidae)

Rozwój *Astiotrema trituri* B. Grabda, 1959
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The life-cycle of the trematodes of the genus *Astiotrema* Looss, 1900 was hitherto completely unknown. It was not before 1958 that N. N. Šewčenko's preliminary report appeared on her studies on the development of *Astiotrema monticelli* Stossich, 1904, commonly occurring in the grass snake — *Natrix natrix* L. on the Ukraine. Simultaneously appeared B. Grabda's report on the development of *Astiotrema* sp. = *Astiotrema trituri* B. Grabda, 1959, which occurs in the intestine of the smooth newt — *Triturus vulgaris* L. in Poland. Accurate data and results of the experimentally carried cycle of this species are presented in the present work. Unfortunately, the lack in N. N. Šewčenko's report of precise data, referring particularly to the morphology of cercariae, makes impossible any comparison of the larval stages of the two species.

The development of *A. trituri* was initially solved on the basis of the morphological similarity of the larval stages and the adult form. The larval stages, cercaria and metacercaria were identified due to the very early development of the gonads and their localization in this species. Into consideration was also taken the relation of the size of the sucker, which is reversed than in the majority of the species of the family *Plagiorchiidae*.

The metacercaria was found by Jarecka in the littoral plankton of the lake Mamry Północne, in *Simocephalus expinosus* Koch. On the basis of the structure of the metacercaria and the stileto found in its cyst, the cercaria previously found by the authoress in the same lake in *Coretus corneus* L. was identified. At the same were found

adult trematodes of this species in the small intestine of the larvae of smooth newts caught at the same points of the lake, where the cercaria and metacercaria were found.

Table I

Tabular arrangement of the examined snails *Coretus corneus* L.

Locality	Number of examined	Number of invaded	Intensity of invasion
Mamry Północne	578	128	22.1
Kortowo	56	13	23.2
Julin	20	2	10.0
Łuże	17	1	5.8

The development was next made experimentally. Several species of *Cladocera* were invaded with the cercariae, and the metacercariae were used for the invasion of the larvae of smooth newts. Adult trematodes of this species were obtained as a result of the invasion. Invasion of snails had to be abandoned because of difficulties encountered in attempts to collect larger quantities of eggs.

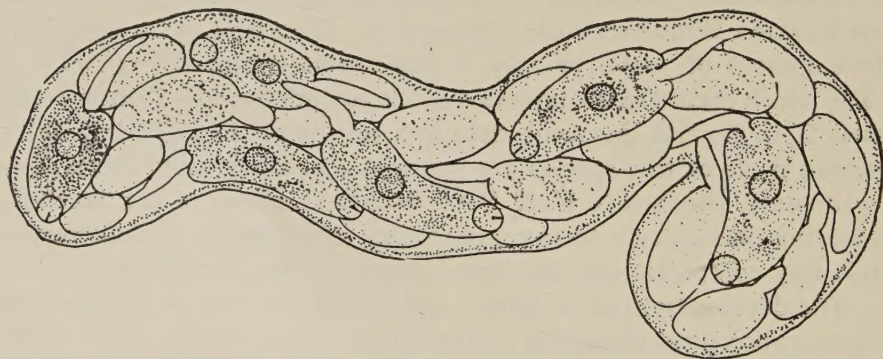


Fig. 1. Sporocyst of *Astiotrema trituri* B. Grabda, 1959

The cercaria of *A. trituri* belongs to the most common in the lake Mamry Północne, it was found in large numbers also in other examined terrains: in Kortowo near Olsztyn, in the Kampinos Wilderness (Łuże) and in Julin near Warsaw.

Sporocysts (Fig. 1). They are relatively large $0.90 - 1.95 \times 0.23 - 0.36$ mm, and contain simultaneously to 10 mature cercariae. They form a compact lump overgrowing the liver of the snail, therefore to isolate them it is very difficult.

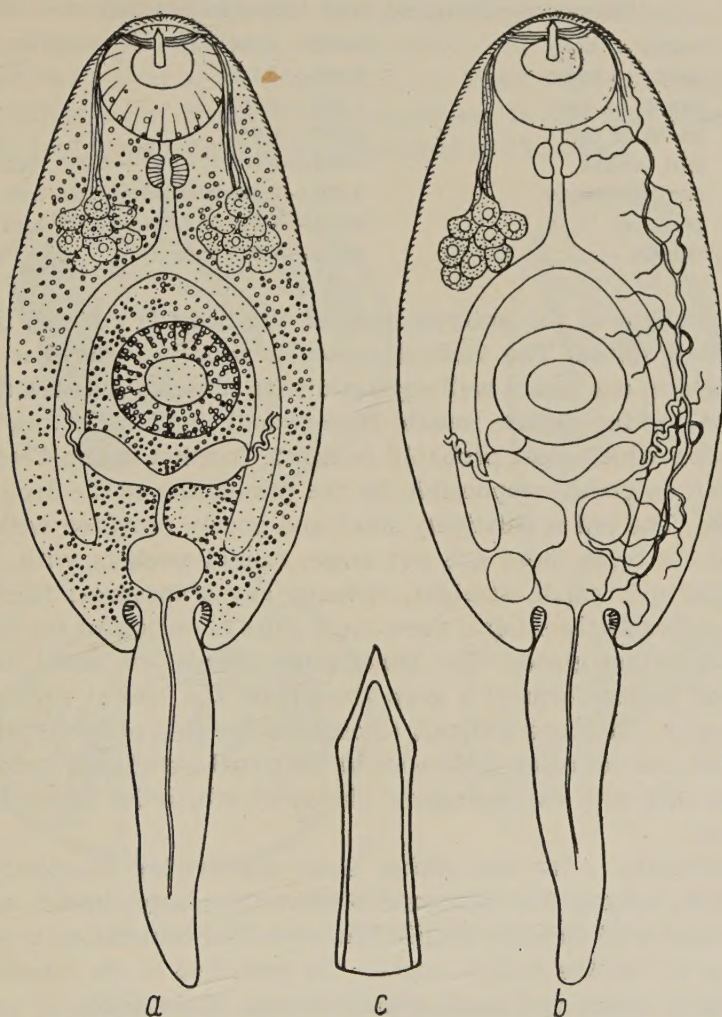


Fig. 2. Cercaria of *A. trituri*. a — external form of cercaria; b — anatomy of cercaria; c — stiletto.

Cercariae (Fig. 2a, b). Maximal production of cercariae occurs in June and July. Later the number of cercariae which leave the snail diminishes considerably. They leave the snail mainly between noon and 4 P. M., swim slowly, awkwardly, close to the bottom of the container. More often they crawl on the bottom and on plants, or they are suspended almost motionless in water.

Dimensions (measured after killing by heating)

length of body	0.312 — 0.384 mm
width of body	0.106 — 0.179 „
length of tail	0.205 — 0.281 „
width of tail	0.034 — 0.042 „
oral sucker	0.056 — 0.068 × 0.056 — 0.059 mm
ventral sucker	0.059 — 0.068 × 0.064 — 0.068 mm
pharynx	0.022 — 0.026 × 0.024 — 0.029 mm
stiletto	0.022 — 0.025 mm

The cuticle of the anterior part of the body is covered densely with small spines. The ventral sucker is usually somewhat larger than the oral one and is well equipped with muscles. Besides this are visible along the radiate muscle fibers small, light reflecting excretion drops, which most probably facilitate fixation to the *Cladocera*. However, no glands responsible for the production of the drops were observed. The tail is relatively short and poorly provided with muscles. At its basis there are not large, caudal pockets with spines. The stiletto is small, straight, without any transversal thickening (Fig. 2c). Beside the stiletto there are 8 pairs of outlets of the ducts of the penetration glands. The penetration glands are small and are arranged in the form of a grape-bunch on the lateral sides of the oesophagus. They are difficult to observe because of their small dimensions and not much difference in the structure of their cytoplasm, as compared with the cystogenic glands by which the whole body is occupied.

Posteriorly to the oral sucker there appears the praepharynx of a medium length. The pharynx is relatively large, broad, and the oesophagus is of medium length. The intestinal bifurcation is at some distance before the ventral sucker, the branches of the intestine are fairly well visible and reach almost the end of the body.

The structure of the excretory system is similar to that in other cercariae of the group *Cercariae armatae*. The vesicle is in the form of the letter Y with lateral canals which take origin somewhat behind the ends of the arms of the vesicle. The flame formula — $2(3 + 3 + 3) + (3 + 3 + 3) = 36$. The flame cells are small and difficult to observe. The excretory canal is present also in the tail.

The anlagen of reproductive organs — ovary and testes, are visible in live cercariae after flattening them and in preparations stained with alum-carmin. The right testis, as in adult trematodes, is situated behind the end of the intestine.

The cercaria belongs to the group *Cercariae armatae* Lühe, 1909, subgroup *Polyadena* Cort, 1914.

Metacercariae (Fig. 3a, b, c). They were observed in natural invasions of *Simocephalus expinosus* in the lake Mamry Północne, 1 — 2 specimens in an individual of *Cladocera*.

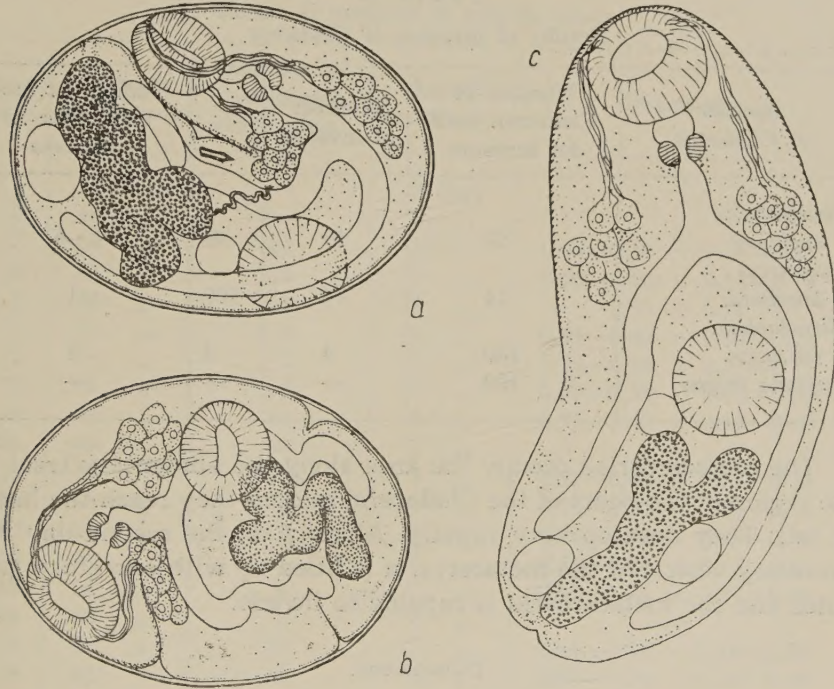


Fig. 3. a — Mature metacercaria from the natural invasion; b — Metacercaria 24 hours old; c — Metacercaria free from cyst.

For experimental invasions were used cercariae which were leaving the snail. The *Cladocera* were controlled by the use of a binocular in order to exclude the possibility of an earlier invasion. The following species were invaded: *Simocephalus expinosus* Koch, *Eurycercus lamellatus* O. F. Müller, *Ceriodaphnia reticulata* G. O. Sars, and *Daphnia magna* Straus.

The main host of the metacercaria of *Astiotrema trituri* proved to be *Simocephalus expinosus* which occurs fairly commonly in the lake Mamry, as well as on the remaining terrains of the Olsztyn and Warsaw environs. The endurance of this species to invasion is also the greatest, although the *Cladocera* in which more than 4 metacercariae

were encountered survived the invasion only exceptionally. Therefore in subsequent experiments the *Cladocera* were invaded with a small number of cercariae and care was taken not to invade one *Cladocera* with more than 1 — 2 cercariae.

Table II
Results of invasion of *Cladocera*

Species of <i>Cladocera</i>	Number of <i>Cladocera</i> used for invasion	Number of invaded	%	Number of metacercariae in <i>Cladocera</i>
<i>Simocephalus expinosus</i>	50	45	90	1—6
<i>Eurycercus lamellatus</i>	14	14	100	1
<i>Ceriodaphnia reticulata</i>	100	4	4	1
<i>Daphnia magna</i>	100	—	—	—

The metacercariae occupy the area along the alimentary tract in the region of the heart of the *Cladocera*, seldom they reach the head, or tail. They develop very rapidly. Already on the second day the excretory vesicle of the metacercaria is filled up with excretory granules and the metacercaria is capable to invade.

Dimensions:

dimensions of the cyst	0.156 — 0.202 × 0.132 — 0.171 mm
length of the trematode	0.358 — 0.390 mm
width of the trematode	0.148 — 0.171 mm
oral sucker	0.053 — 0.058 × 0.056 — 0.058 mm
ventral sucker	0.062 — 0.070 × 0.060 — 0.070 mm
pharynx	0.022 — 0.030 × 0.024 — 0.034 mm
ovary	0.030 — 0.037 × 0.034 — 0.042 mm
Ist testis	0.043 — 0.051 × 0.034 — 0.051 mm
IIInd testis	0.051 — 0.063 × 0.029 — 0.053 mm

The sheath of the metacercaria is very thin and breaks easily, therefore the trematode can be liberated from it without damage. Usually the young metacercaria is a little smaller than the metacercaria counting several days. The reproductive organs are also better visible in older specimens. The penetrating glands are considerably better

visible than in the cercaria due to the use up of the cystogenic material. The glands are preserved during the whole time of the presence of the metacercaria in *Cladocera*.

Table III
Result of invasion of smooth newts

No. of newt	Age of metacercaria	Number of trematodes in a newt	Age of trematodes	Dimensions
1	24 hours	—	2 days	—
2	48 "	—	2 "	—
3	24 "	12	3 "	0.41—0.60 × 0.18—0.25
4	24 "	12	3 "	0.50—0.60 × 0.14—0.19
5	24 "	1	4 "	0.33 × 0.11
6	24 "	6	4 "	0.44—0.62 × 0.14—0.22
7	24 "	7	4 "	0.39—0.58 × 0.13—0.17
8	24 "	8	4 "	0.45—0.58 × 0.14—0.21
9	48 "	11	5 "	0.51—0.62 × 0.16—0.20
10	48 "	—	5 "	—
11	48 "	11	5 "	0.55—0.68 × 0.23—0.31
12	48 "	13	5 "	0.55—0.75 × 0.23—0.31
13	48 "	9	5 "	0.48—0.75 × 0.23—0.31
14	24 "	8	7 "	0.51—0.70 × 0.18—0.24
15	24 "	6	7 "	0.55—0.74 × 0.27—0.31
16	48 "	—	7 "	—
17	48 "	14	7 "	0.43—0.86 × 0.16—0.30
18	48 "	6	8 "	0.80—1.09 × 0.26—0.37
19	48 "	7	13 "	0.78—1.25 × 0.23—0.39
20	48 "	1	33 "	2.18 × 0.64

Adult trematodes. For the invasion were used 20 larvae of smooth newts the age of about one month. The newts were cultivated from eggs laid in an aquarium. They were fed initially with young *Daphnia magna*, later with *Tubifex*. They were invaded once with 10 — 15 metacercaria 1 — 2 days old. Positive results were recorded in 16 newts, in 4 the result was negative.

The trematodes grow very rapidly after reaching the intestine of a newt, however, their penetrating glands (Fig. 4a) remain preserved for about a week and appear quite distinct. During this period the vitellaria become differentiated and the cirrus sac is formed. The trematodes attain 0.5 — 0.7 mm in length (Fig. 4b). The production

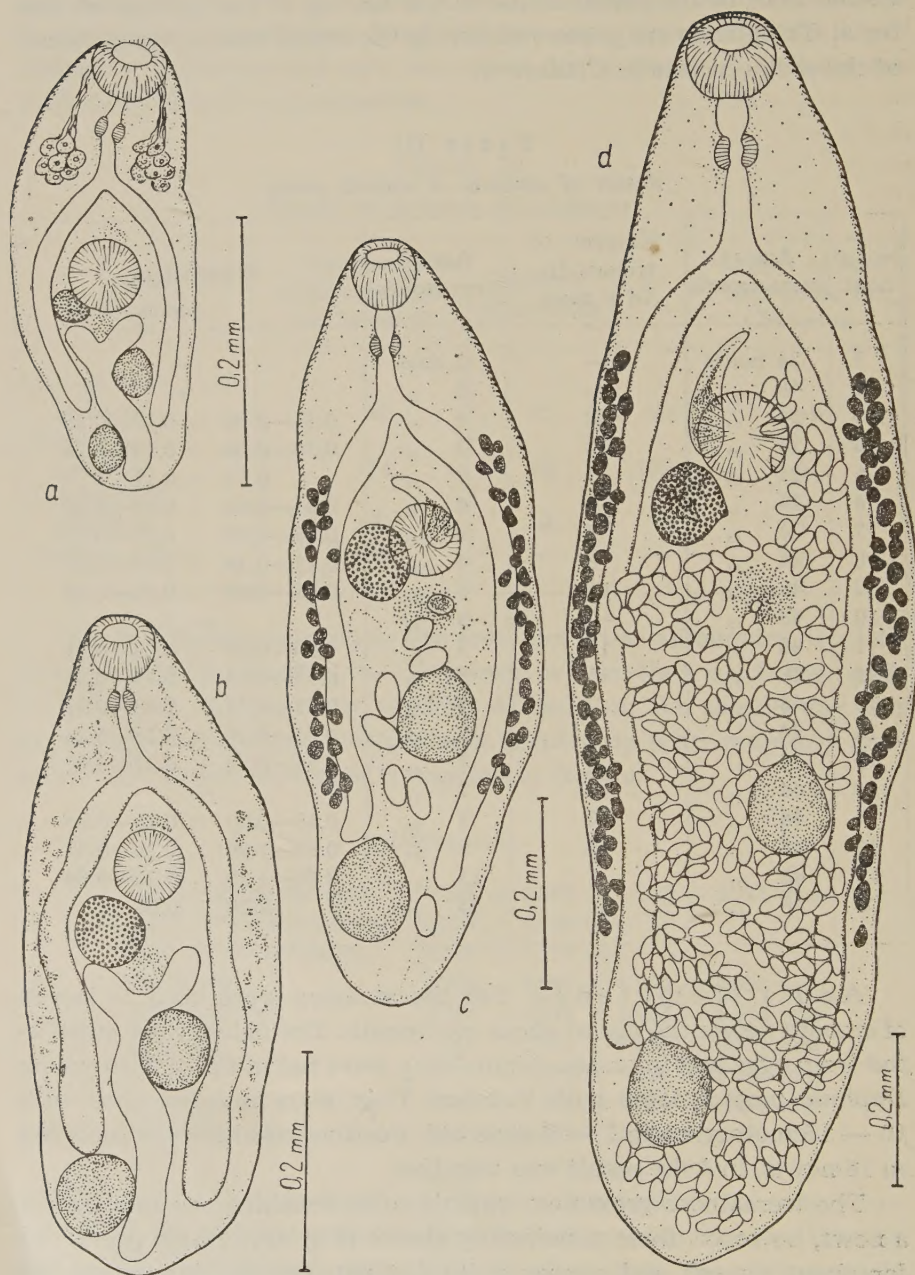


Fig. 4. a — Young trematode 2 days old; b — 7 days old; c — 13 days old; d — adult trematode 33 days old.

of eggs starts at the age of about 2 weeks, when the trematode is 1 — 1.25 mm in length (Fig. 4c). At this time the number of eggs is not numerous and they are irregular, provided with a thin, light shell. During this period were observed for the first time spermatozoa in the seminal receptacle, although the moment of copulation was not noticed. A completely mature trematode was obtained after one month (Fig. 4d), its dimensions 2.18×0.64 mm are close to the upper limit of the dimensions found in this species (2.55×0.89 mm) in natural invasion. The trematode attained already maturity before the newt left water.

On the basis of the experimental development, as well as the data collected from observations of natural invasions entitle to assume that *Astiotrema trituri* is a trematode characteristic to the larvae of newts. This species was found in a natural invasion in 48.5% of the 103 examined larvae and only in 9.8% of adult smooth newts (B. Grabda, 1959). The *Cladocera* being the second intermediate hosts, constitute typical food to the larvae of newts. The short period of time required for the development of the metacercaria, limited to 24 hours, as well as the attainment of sexual maturity of the trematodes already during the period of the larval stage of newts, are an indication of a considerable acceleration of their development and prove that their development is synchronized with the development of the host.

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Warszawa, Pasteura 3

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STRESZCZENIE

Autorka przeprowadziła rozwój przywry *Astiotrema trituri* B. Grabda, 1959, występującej w jelicie cienkim *Triturus vulgaris* L., początkowo na drodze porównania morfologicznego, następnie eksperymentalnie.

Cerkaria *A. trituri* występuje pospolicie na Mazurach i w okolicach Warszawy. Autorka znalazła ją u 21,4 % zbadanych *Coretus corneus* L. Należy do grupy *Cercariae armatae* Lühe, 1909, podgrupy *Polyadena* Cort, 1914. Metacerkarie były znalezione w zarażeniu naturalnym w planktonie jeziora Mamry Pn. u *Simocephalus expinosus* Koch. Eksperymentalnie zarażane były 4 gatunki *Cladocera*: *Simocephalus expinosus* Koch, *Eurycercus lamellatus* O. F. Müller, *Ceriodaphnia reticulata* G. O. Sars i *Daphnia magna* Strauss. Tylko dwa pierwsze gatunki okazały się żywicielami pośrednimi tej przywry. Rozwój metacerkarii jest bardzo szybki i już na drugi dzień są one zdolne do zarażenia. Otrzymanymi metacerkariami zarażane były larwy traszek wyhodowane w akwarium z jaj. Pozytywny wynik uzyskano u 16 spośród 20 zarażanych traszek. Młode przywry rosną i rozwijają się szybko. Już po około dwóch tygodniach od chwili zarażenia zaczynają produkować pierwsze jaja. Po miesiącu przywra osiąga całkowitą dojrzałość, zwykle jeszcze w okresie życia larwalnego traszki.

Szybki rozwój zarówno metacerkarii jak i przywry dorosłej, występowanie wioślarek jako żywicieli pośrednich oraz znacznie częstsze występowanie u larw niż u traszek dorosłych, wskazują, że przywra ta jest pasożytem charakterystycznym dla larw traszek.